"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, A.I.

Continuous line for cutting transformer steel rolls. Mashinostroenie no.2:109 Mr-Ap '62. (MIRA 15:4)

(Cutting machines)

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ENTIN, I.I., inzhener; ZATSEPIN, A.P., tekhnik

Quality control of firebox steel sheets. Stal' 15 no.9:823-825 S'55. (MIRA 8:12)

1. Zavod imeni Petrovskogo
(Sheet steel--Testing)

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ISHCHENKO, A.; ROZENBERG, M.; ZATSEPIN, B.

Relations between foreign trade corporations and soviet suppliers of export goods. Vnesh.torg. 30 no.6:37-41 '60. (MIRA 13:6)

(Russia--Commerce)

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ISHCHENKO, A.; ZATSEPIN, B.

"General conditions of the Mutual Economic Assistance Council, 1958" is a document of far-reaching significance. Vnesh.torg. 28 no.12:9-17 '58. (MIRA 12:1)
(Europe, Eastern--Commerce)

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, D. I.

35562. Klinicheskiye Nablyudeniya O Deystvii Rentgenovskikh Luchey Na Glaz. Sborhik K Pyatidesyatiletiyu Nauch., Ped., Vracheb. I Obshchestv. Deyatel'nosti K. Kh. Orlova. Gor'kiy, 1949, c. 98-108.

Letopis' Zhurnal'nykh Statey, Vol. 48, Moskva, 1949

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, D. I.

Zatsepin, D. I. "Bath for iontophoresis in eye disease cases," Sbornik nauch. trudov (ROst. n/D gos. med. in-t), Vol. VIII, 1948, p. 63-65

SO: U-2888, Letopis Zhurnal'nykh Statey, No. 1, 1949

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, Dmitriy Ivanovich

[X-ray therapy for eye diseases] Rentgenoterapiia glaznykh boleznei. Rostov-na-Donu, Rostovskoe knizhnoe izd-vo, 1959. 139 p. (MIRA 13:8)

(X RAYS--THERAPEUTIC USE)
(EYE--DISEASES AND DEFECTS)

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, E.P.

Comparative pharmacological characteristics of the optical isomers of some aminoalkyl esters of disubstituted acetic and glycolic acids. Farm. i toks. 28 no.1:37-39 Ja-F '65. (MIRA 18:12)

1. Laboratoriya farmakologii (zav. - chlen-korrespondent AMN SSSR prof. S.N.Golikov) Instituta toksikologii Ministerstva zdravookhraneniya SSSR, Leningrad. Submitted May 25, 1963.

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

RAZUMOVA, M.A.; ZATSEPIN, E.P.

Effect of optical isomers of some aminoalkyl esters of disubstituted acetic and glycolic acids on the conditioned reflex activity in dogs. Farm.i toks. 27 no.3:270-273 My-Je '65. (MIRA 18:8)

1. Laboratoriya farmakologii (zav. - chlen-korrespondent AMN SSSR prof. S.N.Golikov) Instituta toksikologii Ministerstva zdravookhraneniya SSSR, Leningrad.

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

3

The lateral extension of Auger showers. [illegible], G. T. Zatsepin, and V. V. Miller (P. N. Lebedev Phys. Inst. Acad. Sci. U.S.S.R., Moscow). *Phys. Rev.* 71, 315-17(1947).—In 1939 Auger and coworkers (C.A. 33, 5786?) observed large atm. showers of cosmic rays capable of causing coincidences in 2 Geiger-Müller counters 40 m. apart and there was some evidence of coincidences at 300 m. In the present paper evidence is presented to show that coincidences above random occur at 600 m. and possibly even at 1000 m. The data were gathered in the Pamir Mountains, 3960 m. above sea level. L. J. E. Hofer

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

CA

Absorption in lead of the particles of atmospheric cosmic-ray showers. G. T. Zatsepin and L. Kh. Eidus (P. N. Lebedev Phys. Inst., Acad. Sci. U.S.S.R., Moscow). *Zhur. Eksptl. Teoret. Fiz.* 17, 937-8(1947).—Measurements made during the 1946 Pamir expedition at 3860 m. with part of the Pb screens replaced by Al showed the absorption in the Al to correspond to an absorption in a Pb layer equiv. to the Al, not with regard to ionization losses, but with regard to radiation losses. This shows the electron-photon character of the shower. The broad dense atm. showers observed under 12-16 cm. Pb evidently consist of high-energy electrons, not of mesons. Generation of mesons within the Pb is, however, not excluded. The expts. confirm the presence of broad meson showers of low d., apparently genetically related to Auger showers. However, the existence of a large no. of broad dense meson showers, or of dense meson accumulations in Auger showers, is not confirmed. N. Thon

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

3A

CA

The nuclear cascade process and its role in the formation of broad atmospheric showers. G. T. Zatsepin (Acad. Sci., U.S.S.R.). *Doklady Akad. Nauk S.S.S.R.* 67, 993-6(1949); cf. Zatsepin and Miller, *J. Exptl. Theoret. Phys.* (U.S.S.R.) 17, 939(1947).—In order to explain certain anomalies observed in cosmic radiation, the following hypothesis is set forth: Broad showers are produced by heavy "nuclear active" particles present in the primary cosmic radiation—the first step involving the formation of a "local" shower (cf. Birger, *C.A.* 43, 2859g) by impact of the primary particle with a nucleus. The "local" shower contains 3 components—a soft electron-photon part, a penetrating part which probably consists of μ-mesons coming from π-meson decay, and a "nuclear active" part. The cascade process is thought to be composed of (1) ordinary cascade multiplication of electron-photon components and (2) a "nuclear cascade" process arising from the "nuclear active" particles created in the "local" shower and generating addnl. "local" showers. The hypothesis is shown to explain qualitatively the fundamental characteristics of showers. M. J. Sienko

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

CA

3A

Density of the particle flux in Auger showers. G. T. Zatsepin, V. V. Miller, I. L. Rosental, and L. Kh. Eidus. *Zhur. Eksptl. Teoret. Fiz.* 17, 1125-7(1947).—The particle flux d. at 3860 m. above sea level in the Pamirs was measured with 6 counter groups in the form of a hexagon 1.6 m. on a side. The effective counter area σ was varied; if C_n is the no. of coincidences of multiplicity n, the results can be expressed by $C_n = B_n\sigma^s$, where $B_2 = 0.054$, $B_4 = 0.017$, $B_6 = 0.0072$ (sq. cm.)$^{-s}$, $s = 1.42$. P. H. Murray

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

Journal of Experimental and Theoretical
Physics, USSR, Vol. 18, No. 3, 1948

Zatsepin, G.T. and Eidus, L.Kh. (P.N. Lebedev Physics Institute, U.S.S.R. Academy of Sciences). Investigation of the penetrating ability of particles of atmospheric showers of cosmic rays, 259-67

"The absorption in aluminum and lead of particles of wide atmospheric showers at a height of 3860 m above sea level was investigated by means of counters. Particles of the shower penetrating 12 cm of lead were identified with the electron-photon component of high energy of the Auger shower. Some evidence was obtained of the possibility of the existence of wide showers of mesons of small density. On the basis of the study of the penetrating ability of the particles of narrow showers, the authors came to the deduction of the existence of two forms of particles in these showers."

Source: GTRSPL, Vol. 1, No. 5, 1948

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T. PA 8/49T103

USSR/Nuclear Physics - Cosmic Radiation Jul 48
Nuclear Physics - Particles

"Penetrating Particles in Wide Atmospheric Showers," G. T. Zatsepin, S. A. Kuchay, I. L. Rozental', Phys Inst imeni P. N. Lebedev, Acad Sci USSR, 3 pp

"Dok Ak Nauk SSSR" Vol LXI, No 1

In summer 1947, at a height of 3,860 meters, the nature of the penetrating particles of wide atmospheric showers was investigated and their density assessed. Describe method and tabulate results. Submitted 24 Apr 1948.

8/49T103

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

PA 11/49T100

ZATESPIN, G. T.

USSR/Physics Jul 48
Magnetic Permeability
Permalloy

"Problem of the Relation of Magnetic Permeability of Permalloy-Type Alloys to Frequency," D. M. Alekseyev, G. T. Zatsepin, I. G. Morozov, Phys Inst imeni P. N. Lebedev, Acad Sci USSR, 4 pp

"Dok Ak Nauk SSSR" Vol LXI, No 3

Reports experiments. Plots and discusses results. Submitted 20 May 48.

11/49T100

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

1360. On the Structure of the Extensive Atmospheric Showers by D M Alekseev, G T Zatsepin and I G Morozov Doklady Akad Nauk SSSR 61 457-458 (1948) July 21 (In Russian)

The fact (Zatsepin and Miller, Zhur Eksptl i Teoret Fiz 17 939 (1947) that the registration of extensive showers is still observable between 2 counter systems S_1 and S_2 at distances reaching 600-1000 m, was submitted to further study at 3860 m altitude. In addition to coincidences C_4 and S_1 and S_2, the coincidences C_5 with a central counter group were recorded. According to the cascade theory, an electron-photon shower has a certain mean-square-root radius R_o (R_o = 100 m for p = 480 mm Hg at the altitude 3860 m), the shower density decreasing rapidly outside R_o. As a consequence, the ratio C_5/C_4 must grow with the distance between S_1 and S_2. The actual measurements showed the opposite effect: the ratio C_5/C_4 decreased from 0.77 ± 0.015 to 0.66 ± 0.075 when the distances grew from 2 to 600 m. These results confirm the hypothesis that the extensive atmospheric showers possess a "structure," perhaps in the shape of

ASB-SLA METALLURGICAL LITERATURE CLASSIFICATION

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

several "trunks" (Skobeltsin, Zatsepin and Miller, Phys Rev 71 315 (1947)).

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APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

PA 55/49T72

USSR/Nuclear Physics - Avalanches Nov 48
Nuclear Physics - Cosmic Rays

"Cascade Curves for Lead," G. T. Zatsepin, 3 2/3 pp

"Dok Ak Nauk SSSR" Vol LXIII, No 3

Asserts that the curves plotted to prove the penetrative ability of avalanches in lead are far more accurate than those calculated according to usual theories. Submitted by S. I. Vavilov 30 Sep 48.

[redacted] 55/49T72

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

USSR/Nuclear Physics - Particles, Elementary — Dec 48

Nuclear Physics - Cosmic Radiation

"Distribution of Penetrating Particles and High-Energy Electrons in Wide Atmospheric Showers," D. M. Alekseyev, G. T. Zatsepin, I. G. Morozov, Phys Inst imeni P. N. Lebedev, 4 pp

"Dok Ak Nauk SSSR" Vol LXIII, No 4

Describes observations made at 3,860-meter altitude. Results prove existence of penetrating particles in atmospheric showers. Considers that proportion of such particles is higher than usual

45/49T100

USSR/Nuclear Physics - Particles, Elementary (Contd) — Dec 48

estimate made by measuring their density and assuming uniform distribution in space. Submitted by Acad S. I. Vavilov, 30 Sep 48.

45/49T100

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

"Problem of the Absorption Curve for Primary Particles of Cosmic Rays," Zhur. Eksper. i Teoret. Fiz., 14, No.12, 1949

Phys. Inst. im. Lebedev

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

"Electron Nuslear Showers in Cosmic Rays and the Nuclear Cascade Process," Zhur. Eksper. i Teoret. Fiz., 19, NO.9, 1949

Phys. Inst. im. Lebedev

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

PA 152T80

USSR/Nuclear Physics - Cosmic Rays Dec 49
"Intercharge"

"Problem of the Absorption Curve for Primary Particles of Cosmic Rays," G. T. Zatsepin, Phys Inst imeni Lebedev, Acad Sci USSR, 4 pp

"Zhur Eksper i Teoret Fiz" Vol XIX, No 12

Shows the "nonmonoenergetic" (nonmonochromatic) form of the spectrum for primary cosmic rays prevents unequivocal treatment of experimental results on absorption of primary cosmic-ray particles. Attempts to explain special nature of absorption curve by process of "intercharge" of proton into neutron and vice versa. Submitted 12 Sep 49.

152T80

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G .T.

Nuclear- Cascade process and its role in the development of broad atmospheric showers. (Presented by Academician D.V. Skobeltsyn* on 23 June 1949. Woek conducted at Physical Institute* imeni Lebedev Of Acadeny fo Sciences USSR.

Reports of the Academy of Sciences USSR Vol. 57, No 6, Sept., 23, 1949.

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

USSR/Nuclear Physics - Radiation,
Cosmic Electron-Photon Component

21 Sep 49

"Formation of High-Energy Electrons and Photons in the Lower Atmospheric Strata by Cosmic Radiation," YA. G. Artukhov, G. T. Zatsepin, L. I. Sarycheva, L. Kh. Eydus, Phys Inst imeni P. N. Lebedev, Acad Sci USSR, 3¼ pp

"Dod Ak Nauk SSSR" Vol LXVIII, No 3

Describes study of high-energy electron-photon component conducted in summer 1948 on the Pamirs. According to experimentally confirmed hypothesis, secondary nuclear-active particles are formed when special showers are generated, causing a nucleocascade process. Fundamental significance of this process must be admitted not only in development of wide showers but also in formation of high-energy electron-photon component in lower strata of atmosphere. Submitted by Acad D. V. Skobel'tsyn 22 Jul 49

PA 149T78

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN G. T.

USSR/Nuclear Energy - Cosmic Rays Showers 11 Nov 49

"Generation of Electron-Photon Components of High Energy," G. Ya. Artyukhov, G. T. Zatsepin, L. I. Sarycheva, L. Kh. Eydus, Phys, Inst imeni Lebedev, Acad Sci. USSR, 4 pp

"Dok Ak Nauk SSSR" Vol LXIX, No 2

Confirms previous conclusion that appearance at average heights of high-energy electrons is generally explained by their generation in the depths of the atmosphere by nuclear-active particles composing wide atmospheric showers ("special" showers in the aid). Data used was gathered in summer 1948 at 3,860 meters elevation with aid of hodoscopes. Electrons and photons studied had energies as high as 2-3·109 ev. Submitted 22 Jul 49 Acad D. V. Skobel'tsyn.

PA 157T74

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

35818 Spektr plotnostey potokov pronikayushchikh chastits shirokikh atmosfernykh livney kosmicheskikh luchey. Avt. G. T Zatsein, I. L. Rozentalv, S. A. Slavatinskiy (I dr.) Doklady akad nauk sssr, novoay seriya, t. Lxix, no. 3, 1949, s. 341-43 Bibliogr: 9 Nazv

SO: Letopis' Zhurnal'nykh Statey, vol. 49, Moskva, 1949

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

158T76

ZATSEPIN, G. T.

USSR/Nuclear Physics - Cosmic Rays 21 Nov 49
Particles, Elementary

"Absorption Spectrum of Penetrating Particle Currents of Wide Atmospheric Showers in Cosmic Rays," G. T. Zatsepin, I. L. Rozental', S. A. Slavatinskiy, G. B. Khristiansen, L. A. Shyvayev, Phys Inst imeni Lebedev, Acad Sci USSR, 3 pp

"Dok Ak Nauk SSSR" Vol LXIX, No 3

Employed usual method of variation of area of counters, connected in coincidence scheme, and method of variation of "coincidence multiples," to determine subject spectrum and clarify nature of penetrating particles. Submitted 22 Jul 1949 by Acad D. V. Skobel'tsyn.

158T76

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

USSR/Nuclear Physics - Cosmic Rays Showers — Dec 49

"Altitude Behavior of the Penetrating Component of Wide Atmospheric Showers of Cosmic Rays," G. T. Zatsepin, I. L. Rozental', S. A. Slavatinskiy, Phys Inst imeni P. N. Lebedev, Acad Sci USSR, 4 pp

"Dok Ak Nauk SSSR" Vol LXIX, No 4

Gives results of observations conducted in summer 1948 on Pamir at 3,860 and 4,700 meters. Number of coincidences per hour for various thicknesses of lead (0, 12, 20, 28, and 36 cm) was registered at both heights. Number of coincidences for 28 cm of

155T48

155T48

USSR/Nuclear Physics - Cosmic Rays (Contd) — Dec 49

lead was approximately 1.9 at 3,860 meters and 3.5 at 4,700 meters; for 36 cm of lead, there were no coincidences at 3,860 meters and 3.2 at 4,700 meters. Submitted by Acad D. V. Skobel'tsyn 22 Jul 49.

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APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

ZATSEPIN, G. T.

PA 152T76

USSR/Nuclear Physics - Cosmic Rays Particles, Nucleoactive — 11 Dec 49

"Nucleoactive Particles in Wide Atmospheric Showers," G. T. Zatsepin, L. I. Sarycheva, Phys Inst imeni Lebedev, Acad Sci USSR, 4 pp

"Dok Ak Nauk SSSR" Vol LXIX, No 5

Measurements confirm the presence, in wide atmospheric showers, of nucleoactive particles of high energy which generate electron-nuclear showers. Number of such particles can be evaluated as 0.1-1% of the number of electrons in the shower and as 30 meters

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USSR/Nuclear Physics - Cosmic Rays (Contd) — 11 Dec 49

wide in spatial distribution. True ratio of the full number of nucleoactive particles to the full number of penetrating particles in a shower can be determined only when we know the spatial distribution as with other particles. Submitted by Acad D. V. Skobel'tsyn 21 Oct 49.

152T76

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

N

8

6444 Structure of Abnormally Extensive Atmospheric Showers of Cosmic Radiation. D. V. Skobel'tsyn and G. T. Zatsepin. Doklady Akad. Nauk S.S.S.R. 73, 1137-40(1950) Aug. 21. (In Russian)

At 3860 m altitude, the authors had observed (Phys. Rev. 71, 315(1947)); Doklady Akad. Nauk S.S.S.R. 67, 65 and 255 (1949)) very extensive showers (up to 1000 m diameter) whose structure appeared to differ from that of the ordinary atmospheric showers; instead of one central dense trunk, they revealed the presence of several such trunks. Since Cocconi (Phys. Rev. 72, 350(1948)) contested that view, a crucial experimental setup is proposed here. To the two counter groups, separated by a distance of 1000 m, used in the previous work, a third group, placed in the middle, is now added and is used to record anticoincidences with the outer groups working in coincidence. In the case of an ordinary extensive-shower structure, the probability of such anticoincidences, as deduced from the cascade theory, is practically equal to zero. The experimental work based on the application of this method was done by Zatsepin et al. (Doklady Akad. Nauk S.S.S.R. 74, 29(1950)).

ASA-SLA METALLURGICAL LITERATURE CLASSIFICATION

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

ZATSEPIN, G. T.

PA 174T42

USSR/Nuclear Physics - Showers
Cosmic Rays

1 Sep 50

"Observations of Atmospheric Showers of Cosmic Rays Greater Than 1,000-Meter Width," G. T. Zatsepin, Phys Inst imeni Lebedev, Acad Sci USSR

"Dok Ak Nauk SSSR" Vol LXXIV, No 1, pp 29-32

Discusses data on superwide atmospheric showers obtained in summer 1949 at 3,860 m (see D. V. Skobel'tsyn and Zatsepin, "Dok Ak Nauk SSSR" Vol LXXIII, No 6, 1950, for description of instruments). Submitted 29 Jun 50 by Acad D. V. Skobel'tsyn.

[redacted]

174T42

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

USSR/Physics - Photofission 1 Oct 51

"Photofission of Heavy Cosmic-Ray Particles Occurring Under the Influence of Solar Radiation," G. T. Zatsepin

"Dok Ak Nauk SSSR" Vol LXXX, No 5, pp 577, 578

For high energies of the atomic nuclei of cosmic rays, photofission of these nuclei by photons of the sun's rays is possible by virtue of the Doppler effect. Av energy of photons from sun is 3 ev; but nuclear photoeffect requires photon energies of 10^7 ev. Finds the probability W of photofission

222T72

of a nucleus in space to be 10^{-4}. Concludes that subject effect can be observed, and cause wide atm showers. Submitted 23 Jul 51 by Acad D. V. Skobel'tsyn.

222T72

ZATSEPIN, G. T.

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

USSR/Nuclear Physics - Cosmic Rays Feb 52

"Electron-Nuclear and Broad Atmospheric Showers of Cosmic Rays," Yu. V. Anishchenko, G.T. Zatsepin, I.L. Rozental, L.I. Sarycheva, Phys Inst imeni Lebedev, Acad Sci USSR

"Zhur Eksper i Teoret Fiz" Vol XXII, No 2, pp 143-151

Studies electron-nuclear showers. Concludes that such showers occur not only in heavy (Pb), but also in light elements (C). High-energy shower particles produce secondary showers, a proof of nuclear cascade processes (cf G T. Zatsepin, "Dok

207T99

USSR/Nuclear Physics - Cosmic Rays (Contd) Feb 52

Ak Nauk SSSR" Vol LXVII, 933, 1949). Density of beam of active nucleons is found proportional to density of electron beam. Indebted to Acad D.V. Skobeltsyn, Prof N.A. Dobrotin, G.B. Zhdanov, M.I. Podgoretskiy. Received 10 May 51.

207T99

ZATSEPIN, G. T.

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G., DOBROTIN, N., VERNOV, S.

NUCLEAR PHYSICS

Again on the existence of varitrons (concerning A. I. Alikhanyan's reply to our article on varitrons). Zhur. eksp. i teor. fiz. 22 no. 4, 1952.

Monthly List of Russian Accessions, Library of Congress. November, 1952. Unclassified

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T. (Scientist)

An article entitled "Chastitsy iz kosmosa" (Particles from the Cosmos) deals with cosmic rays and is illustrated with 2 photos and a schematic drawing. By N. G. Birger and L. Kh. Eydus, Bachelors of physico-mathematical sciences. The following Soviet scientists are mentioned: A. I. Alikhanov, A. I. Alikhanyan, D. V. Skobel'tsyn, N. A. Dobrotin and G. T. Zatsepin.

SO: Naukaizhizn, #8, Moscow, August 1953 (147826)

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

USSR/Nuclear Physics - Cosmic Rays Feb 53

"Wide Atmospheric Showers of Cosmic Rays," N. A. Dobrotin, G. T. Zatsepin, I. L. Rozenthal, L. I. Sarycheva, G. B. Khristiansen, L. Kh. Eydus

Usp Fiz Nauk, Vol 49, No 2, pp 185-242

First showers were observed by D. V. Skobeltsyn in 1929 (Z. F. Physik, 54 (1929)) and later in 1949 he detected gigantic showers on Mt Pamir (3860m) (DAN 67 (1949)). G. T. Zatsepin developed the new theory of wide showers (DAN 67, 1949)) followed by foreign scientists. 78 references, mostly American (18)

251T57

appended. Indebted to Acad Skobel'tsyn, Ye. L. Feynberg, S. Z. Belenkiy, M. I. Pogoretskiy.

251T57

IA 251T57

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

Dissertation: "Broad Atmospheric Showers and a Nuclear Cascade Process." Dr Phys-Math Sci, Physics Inst imeni P. N. Lebedev, Acad Sci USSR, 21 Jun 54. Vechernyaya Moskva, Moscow, 28 May 54.

SO: SUM 284, 26 Nov 1954

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G.T.

USSR/Physics - Nuclear physics

Title : ... nuclear cascade process.

Periodical : ... 1954

Abstract : ... theory of the nuclear cascade process is presented. It is based on the ...

Institution: Physical Institute im. P.N. Lebedev of the Acad. of Scs. of the USSR

Presented by: Academician ... Skobel'tsin, ... 5, 1954.

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

USSR

Card

Authors : Zatsepin, ..., and ...

Periodical : Dok. AN SSSR 99/6, 951-954, Dec 21, 1954

Abstract : A question on a number of atmospheric showers of primary particles of a ... is discussed. By assum-

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

A ST[illegible] OF NUCLEON INTERACTION WITH LIGHT NUC[illegible] AT THE ENERGY RANGE OF $10^{[illegible]} \div 10^{14}$ ev. [illegible] [illegible] Grigorov, G. T. Zatsepin, and A. E. [illegible]

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

DOBROTIN, N.A.; ZATSEPIN, G.T.; NIKOL'SKIY, S.I.; SARYCHEVA, L.I.; KHRISTIANSEN, G.B.

Investigation of the interaction of high-and superhigh-energy particles with nucleons and atomic nuclei. Izv.AN SSSR Ser.fiz.19 no.6:666-676 N-D '55. (MLRA 9:4)

1.Fizicheskiy institut imeni P.N.Lebedeva Akademii nauk SSSR i Moskovskiy gosudarstvennyy universitet imeni M.V.Lomonosova.

(Cosmic rays) (Nuclear physics)

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

JANOSSY, L.

21(1) PHASE I BOOK EXPLOITATION HUN/1911

International Conference on Cosmic Radiation. Budapest, 1956.

International Conference on Cosmic Radiation Organized by the Hungarian Academy of Sciences. Budapest, 1957. 187 p. 200 copies printed.

Sponsoring Agency: Magyar Tudomanyos Akademia

Eds.: E. Fonyves, and A. Somogyi

PURPOSE: This report is intended for geophysicists concerned with cosmic radiation.

COVERAGE: This report contains the papers read at the six plenary sessions of the conference. Some of the problems dealt with include nuclear emulsions, extensive air showers and the program of cosmic ray measurements planned for the International Geophysical Year. Most of the reports are followed by references. Soviet scientists in the field of cosmic radiation who attended the conference are: E.L. Andronikashvili, N.A. Dobrotin, I.I. Gurevich, S.I. Nikolskiy and S.N. Vernov. The articles are written in English, German and Russian without parallel translations.

Card 1/6

International Conference (Cont.) HUN/1911

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G.T.

PA - 2665

AUTHOR: ANTONOV,YU.N., VAVILOV,YU.N., ZATSEPIN,G.T., KUTUZOV,A.A., SKVORTSOV,YU.V., KHRISTIANSEN,G.B.

TITLE: Structure of the Periphery of Extensive Atmospheric Cosmic Ray Showers. (Struktura periferii shirokikh atmosfernykh livney kosmicheskikh luchey, Russian).

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 2, pp 227-240, Russian)

Received: 5 / 1957 Reviewed: 6 / 1957

ABSTRACT: The present paper investigates the spatial distribution of the different components of a broad atmospheric cosmic ray shower at great distances from its axis (200 - 800 m). For a detailed study of this problem the Pamir-Expedition of the Academy of Science of the U.S.S.R. (summer and autumn 1950 and 1951) used a new method: In different places of the observation plain the flux density of all charged particles (and separate from it that of penetrating particles) was simultanously determined with hodoscopic devices. (Method of correlated hodoscopes).

Summary of results: The shower domain investigated here consists of an electron-photon component and of a penetrating component (apparently myons). With increasing distance from the shower axis the relative share of the penetrating component increases considerably and at a distance r = 800 m the flux density of penetrating particles and of electrons is equal. The spatial distribution of the

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PA - 2665

Structure of the Periphery of Extensive Atmo-- spheric Cosmic Ray Showers.

total flux density of electrons and of penetrating particles is determined by the formula $\varrho(r) \sim 1/r^n$ with $n \sim 2,0$. On account of the relatively slow decrease of flux densities of shower particles the periphery of the shower plays an essential part in the general balance of the flux of the shower particles. The mechanism of the transition of electrons to the periphery of the shower is reduced to the Coulomb scattering of these electrons by the nuclei of air atoms. The transition of Myons to the periphery of the shower is effected by their Coulomb scattering and also apparently at the expense of the emission angle in the elementary acts of the nucleus cascade process of the positive and negative myons producing these myons. Finally, data on the intensity of primary cosmic particles with extremely high energies of 10^{16} up to 10^{17} eV are given. (10 illustrations)

ASSOCIATION: Physical Institute "P.N.Lebedev" of the Academy of Science of the U.S.S.R.

PRESENTED BY:

SUBMITTED:

AVAILABLE: Library of Congress.

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSepin, G.T.

PA - 2687

AUTHOR GUZHAVIN, V.V., ZATSEPIN, G.T.

TITLE The Courses Taken by the Heights of the Broad Atmospheric Showers according to Different Models of the Elementary Act of Nuclear Collision. (Vysotnyy khod atmosfernykh livney soglasno raslychnym modelyam elementarnogo akta yadernykh stolknoveniy - Russian).

PERIODICAL Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 2, pp 365-366 (U.S.S.R.)

Received 5/1957 Reviewed 6/1957

ABSTRACT The development of the nuclear and the electron-photon components of the broad atmospheric showers in the atmosphere are computed for three different energies of the primary protons (10^{14}, 10^{16}, 10^{18} eV) with two varieties of the model of the nuclear collisions. In both varieties the free length of path of the nucleons and pions was assumed to be independent of energy and equal to 65 g/cm², which corresponds to the geometric cross section of the nucleons of air atoms. The first variety describes the production of particles on the occasion of nuclear collisions at energies of the nucleons and pions exceeding 5.10^{12} eV by means of the theory by LANDAU. Some other assumption are also made. In the second variety assumes a nucleon of any energy (also for $E > 5.10^{12}$ eV) to lose only 30°/o of its energy by the production of mesons at nuclear collisons to retain the remaining 70°/o. Furthermore, only π^{+-0} +Mesons are to be produced on the occasion of collisions. Development of avalanches of nuclear particles was computed for both varieties by means of the method of successive deviations under consideration of the decay of π^{+-}-mesons.

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The Courses Taken by the Heights of the Broad Atmospheric PA - 2687
Showers According to Different Models of the Elementary Act of Nuclear Collision.

The electron-photon avalanches resulting from neutral pions were summarized graphically. The results of computations according to both varieties are shown together in a table. The experimental data determined from the height dependence of the number of showerd originating from protons with from $E \sim 10^{14}$ to 10^{16} eV., agrees best with the assumption that on the occasion of nuclear collisions, the nucleon loses only 30% of its energy. The results obtained here are an important argument for the fact that the nucleon at $E > 5.10^{12}$ eV (at least up to $E \sim 10^{14}$ or 10^{15} eV) lose at the utmost 1/3 of its energy on the occasion of collisions with the nuclei of air atoms. In the case of extremely high energies ($E\ 10^{18}$ eV), however, a considerable decrease of nucleon energy on the occasion of nuclear collisions must be assumed.
(1 table)

ASSOCIATION Physical Institut "P.N.LEBEDEV" of the Academy of Sciences on the USSR.
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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

56-2-4/51

AUTHORS: Zatsepin, G. T., Krugovykh, V. V., Murzina, Ye. A., Nikol'skiy, S. I.

TITLE: The Study of High-Energy Nuclear-Active Particles by Means of an Ionization Chamber (Nablyudeniye yaderno-aktivnykh chastits vysokoy energii pri pomoshchi ionizatsionnykh kamer)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1958, Vol 34, Nr 2, pp 298-300 (USSR)

ABSTRACT: In autumn 1955 the authors investigated at an altitude of 3860 m above sea level nuclear-active particles of high energy ($E > 10^{11}$ eV). The apparatus used for these measurements consisted of 6 impulse-ionization chambers which were mounted below a lead layer of variable thickness. The ionization chambers consisted of brass cylinders. An electronic device made possible the registration of the intensity of the ionization impulse in each of the 6 chambers. Beside the ionization chambers there was a system of 972 hodoscopic counters with a total surface of ~ 10 m^2. The distribution of frequencies of the ionization bursts as

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The Study of High-Energy Nuclear-Active Particles by Means of an Ionization Chamber 56-2-4/51

a function of their intensity (below different filters) it shown in a diagram. The integral spectra of the bursts with $N > 2000$ relativistic particles can be expressed by an exponential law:

$$\nu \ (\geqslant N) = A/N^{\gamma}$$

Here the exponent γ is the same with all three spectra (20, 50 and 80 cm thick lead layers); it is on the average $\bar{\gamma} = 1,5 \pm 0,16$. The absolute frequencies of the ionization bursts belon 20 cm and 50 cm of lead coincide within the range of error, limits. The range for the absorption of the nuclear active component in air is ~ 120 g.cm^{-2}. This value is obtained in different ways. In the analysis of the correlation of ionization bursts with atmospheric showers the cases observed were divided into two groups:
1.- Ionization bursts which are accompanied by an atmospheric shower of small density. 2.- Ionization bursts which are accompanied by a broad atmospheric shower of more than 10^3 particles. The result of this analysis is shown in a

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The Study of High-Energy Nuclear-Active Particles by Means of an Ionization Chamber

diagram as follows: With increasing intensity of the ionization burst also the probability of air escort increases (vozduzhnoye soprozhdeniye). In 25 % of the cases the authors observed bursts which can be explained by a simultaneous entrance into the detector of at least two nuclear active particles of high energy. The authors investigated the showers with a number of particles from 7.10^4 to 7.10^5. The distribution of the frequency of the ionization bursts produced by the nuclear-active particles of the wide atmospheric shower with respect to their density is shown in a diagram. The frequency of bursts decreases with increasing thickness of the lead layer. The distribution with respect to the density of the showers accompanying wide atmospheric showers can be represented by the exponential function with the exponent $\gamma = 0,9 \pm 0,2$. The spectrum of the nuclear active component in a wide atmospheric shower of $\sim 10^5$ particles can be represented in the interval of energies of from 5.10^{11} to 10^{13} eV in the form $E^{-0,9 \pm 0,2}$. But the real spectrum can be different from the one given here because of the simultaneous entrance of

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

The Study of High-Energy Nuclear-Active Particles by Means of an Ionization Chamber 56-2-4/51

several nuclear-active particles on the surface of the detector.
There are 3 figures, 1 table, and 1 reference, 1 of which are Slavic.

ASSOCIATION: Institute of Physics imeni P. N. Lebedev AS USSR (Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSR)

SUBMITTED: July 20, 1957

AVAILABLE: Library of Congress

1. Ionization chambers-Performance 2. Ionization chambers-Characteristics 3. Particles-Study and teaching

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

24(5) SOV/56-35-4-1/52

AUTHORS: Guseva, V. V., Zatsepin, G. T., Khristiansen, G. B.

TITLE: On the Angular Distributions of Broad Atmospheric Showers of High Energy (Ob uglovom raspredelenii shirokikh atmosfernykh livney vysokikh energiy)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 4, pp 833-837 (USSR)

ABSTRACT: The present paper deals with experimental investigations of the angular distribution carried out for the purpose of determining the absorption coefficients of high-energy showers (primary particle energy $\gtrsim 10^{17}$eV). The experiments were carried out in an altitude of 3860 m above sea-level. The authors used a cylindrical cloud chamber (illumination depth 6 cm) which had an effective surface of 615 cm^2. The cloud chamber was synchronously connected with a system consisting of many counters (hodoscope arrangement); the photographic equipment was arranged so that the optical axis of the stereoscopic camera formed an angle of 30° with the vertical. The counters were arranged in 5 groups so that there was a horizontal distance of

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

On the Angular Distributions of Broad Atmospheric Showers of High Energy

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500 m between each of the first three, whilst the 4. and 5. were 300 m above and under the central group respectively. 5 m above the central group the Wilson chamber was located. The results obtained by the investigation are shown partly by table 3 and figure 4. A total of 75 showers was investigated. Results show that, contrary to the usual opinion, such showers have already passed the maximum of their development in altitudes of several 1000 m above sea-level.
In conclusion, the authors thank N. A. Dobrotin and N. G. Birger for their assistance and advice, and E. S. Levit for helping to carry out measurements. There are 4 figures, 3 tables, and 7 references, 6 of which are Soviet.

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SOV/56-35-4-1/52

On the Angular Distributions of Broad Atmospheric Showers of High Energy

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute imeni P. N. Lebedev of the Academy of Sciences, USSR)
Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: January 7, 1958

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

A STUDY OF THE CORES OF INDIVIDUAL AIR SHOWERS

N.N. Goryunov, A.D. Erlykin, A.B. Kamnev, G.T. Zatsepin

1. An apparatus has been devised consisting of 128 cubic ionization chambers arranged in two layers 2 m by 2 m, one above the other. The upper chambers are shielded by 2.5 cm thick lead. The lower layer of ionization chambers is shielded by a combination filter consisting of 7.5 cm lead on top, a 70 cm thick layer of graphite and a 2.5 cm thick layer of lead directly above the chambers.

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

THE ENERGY SPECTRUM OF NUCLEAR-ACTIVE PARTICLES OF COSMIC RAYS AT 3860 METERS ALTITUDE, AND ASSOCIATED EXTENSIVE AIR SHOWERS

S.I. Dovzhenko, G.T. Zatsepin, YE.A. Murzina, S.I. Nikolsky, V.I. Yakovlev

1. The energy spectrum of nuclear-active particles has been investigated by means of cylindrical ionization chambers of total area I m^2 placed under lead layers of 20, 50, and 80 cm, and also by means of flat ionization chambers of are 2 m^2 placed in a lead block with an 8 cm thick top cover surmounted by a layer of graphite of varying thickness (25 - 65 cm.) To register the extensive air showers the first series of measurements was made by hodoscope counters, and the second, by ionization chambers.

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959.

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4"

"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

Zatsepin, G. T.

TRAVERSAL OF HIGH ENERGY μ -MESONS THROUGH THICK LAYERS

I. S. Alekseyev, G. T. Zatsepin

1. The absorption of cosmic ray μ -meson flux was calculated by solving a kinetic equation which takes into consideration the fluctuations in the energy losses of high energy μ -mesons.

2. An integral μ -meson energy spectrum at sea level was obtained by comparing calculated and experimental data for μ -meson rock absorption. It was found, taking account of fluctuations, that the meson flux intensity, with energy E 10^{12} ev, drops by a factor of 1.5 as compares with the results obtained ignoring fluctuations.

3. The large effective cross section for the process of direct pair production, in principle, makes it possible to measure the energy of individual μ -mesons, with an energy of E 10^{12} ev, by means of multilayer ionization chambers separated by lead.

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

G.T. Zatsepin

THE ROLE OF FLUCTUATIONS IN THE DEVELOPMENT OF AIR SHOWERS

G.T. Zatsepin

1. Experimental data on air showers at sea level with the total number of particles $N \approx 10^5$ show that there are very great fluctuations in their characteristics (the energy of different components, core structure, etc.).

2. The presence of fluctuations in shower development leads to ambiguous relationships between the energy of the primary particle and the number of particles in the shower at a given level. Due to the large value of the exponent of the primary energy spectrum ($\gamma \simeq 1.7$), fluctuations lead to a reduction in the mean energy of the primary particles responsible for showers with the given number of particles (N).

3. Large fluctuations in shower characteristics and the low energy of the electron-photon component of the shower cores agree with an earlier conslusion that is the greater part of nuclear collisions nucleons of energy right up to 10^{14} - 10^{15} ev retain a considerable portion of their energy.

4. When analysing experimental data account of fluctuations in the developement of showers yields a slightly larger coefficient of inelasticity ($K_{''} \simeq 1/2$) than that obtained earlier when fluctuations in shower development were ignored ($K_{''} \simeq 1/3$).

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

CALCULATION OF CERTAIN CHARACTERISTICS OF AIR SHOWERS BY THE MONTE CARLO METHOD

L. Dedenko and G.T. Zatsepin

1. A calculation is made of the probability of observing a shower with an arbitrarily given number of particles at sea level and a fixed energy of the primary proton: 10^{13} ev, 10^{14} ev, 10^{15} ev. An elementary model of nuclear collisions is used. The coefficient of in elasticity for the nuclions is taken to be K $\mathcal{N}$ =1/2; for pi-mesons K_π =1.
2. The distributions obtained yield a large ambiguity between the number of particles in the shower at sea level and the energy of the primary proton.
3. A comparsion is made of the results of calculations with the experimental number of showers observed at sea level. The intensity of the primary particles with energy 10^{13} - 10^{15} ev than calculated from these data is less by a factor of 1.5 than that calculated ignoring fluctuations.

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

31521
S/627/60/002/000/003/027
D299/D304

3.2410 (1559, 2705, 2805)

AUTHORS: Goryunov, N. N., Yerlykin, A. D., Zatsepin, G. T., and Kamnev, A. B.

TITLE: Study of cores of individual air showers

SOURCE: International Conference on Cosmic Radiation. Moscow, 1959. Trudy. v. 2. Shirokiye atmosfernyye livni i kaskadnyye protsessy, 71-79

TEXT: The experimental setup is described; the results of the experiments are given. The principal apparatus consists of a system of ionization chambers which operated in conjunction with the complex setup of Moscow State University (see article on p. 5, same Trudy). The ionization chambers were disposed in two rows of 60, respectively 64 chambers each. The large number of chambers made it possible to obtain a continuous pattern of ionization distribution in space. The lower row was shielded by a triple layer Pb-C-Pb. The graphite layer acted like a converter of energy (of nuclearactive particles into electron-photon energy). The energy fraction

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D299/D304

imparted to π^0-mesons was estimated; it was found to be approx. 0.2 to 0.37. In processing the results, the main attention was devoted to the case when the shower axis passed through the ionization chamber system. According to cascade shower theory, the axis of high-energy showers can be localized in a small region. It was found that this holds also in practice. The position of the axis was determined by two independent methods, without any discrepancy. The showers recorded during a certain time interval were represented as a "point field", whose abscissas and ordinates give the total number of particles in the shower and the energy flux in the core, respectively. In order to ascertain the relationship between the number of particles N and the corresponding mean energy flux E, the various points were averaged. It was found that for $N = 10^5$, $E = 10^4$ relativistic particles. To one and the same intensity of shower there corresponds a whole range of values E, whereby the spread of the points increases with decreasing intensity of shower. The character of the ionization distribution in the vicinity of the shower core varies. In the majority of cases, the shower has an

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

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Study of cores ...

elementary structure, i.e. the ionization density has one sharp maximum. In some cases, a broadening of the core was observed; thus, out of 39 showers with N 10^5, one third belong to complex-structure showers. It was found that the ionization-density distribution can be expressed (in the majority of cases) by a power law of type $\rho(r) \sim 1/r^n$, up to $r \cong 1.5$ m and various n. The lateral distribution function of the energy flux of the nuclearactive component was constructed. The mean energy flux of the nuclearactive component was found to be $4.6 \cdot 10^3$ rel. particles = $2.3 \cdot 10^{12}$ ev. This was compared with the mean energy of the electron-photon component: $2.8 \cdot 10^4$ rel. particles = $2.8 \cdot 10^{12}$ ev. Integrating the lateral-distribution function of high-energy nuclearactive particles over a radius of 2.5 m about the axis, it was found that such a circle contains 0.9 particles with an energy $> 5 \cdot 10^{11}$ ev. (for showers with $N = 10^5$). Further, the energy spectra of nuclearactive particles in the central regions of showers of various intensity were con-

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D299/D304

Study of cores ...

sidered. Finally, the observed energy flux of the electron-photon component was compared with that calculated according to cascade theory. It was found that the calculated energy-flux exceeded the observed one by a factor of 3 (for r = 1.5 m), and by a factor of 8 (for r = 12 cm). There are 9 figures and 12 Soviet-bloc references.

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

31530
S/627/60/002/000/012/027
D299/D305

3,2410(1559,2205,2705)

AUTHORS: Dovzhenko, O. I., Zatsepin, G. T., Murzina, Ye. A., Nikol'skiy, S. I., and Yakovlev, V. I.

TITLE: Energy spectrum of nuclearactive component of cosmic radiation at 3860 m, and related extensive air showers

SOURCE: International Conference on Cosmic Radiation. Moscow, 1959. Trudy. v. 2. Shirokiye Atmosfernyye livni i kaskadnyye protsessy, 144-151

TEXT: Two series of experiments are described, of 1955 and of 1957. The apparatus used in 1957 permitted detecting extensive air showers exceeding 1000 particles only. The relation is established between the nuclearactive particles and the ionization bursts in the chambers. Computations showed that if the integral energy-spectrum of the incident nuclearactive particles is expressed by the power law $f(>E) = AE^{-\gamma}$, then the ionization spectrum is also described by a power law with the same γ. The experimentally obtained

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Energy spectrum of ...

energy spectrum of the nuclearactive component is plotted in a figure. From the figure it is clear that the integral energy spectrum of nuclearactive particles in the range of 10^{12} to $5 \cdot 10^{13}$ ev., can be expressed in the form $f(>E) = AE^{-\gamma}$, where $\gamma = 1.5 \pm 0.1$. The absolute intensity of the nuclearactive particles with energy $\geqslant 10^{12}$ ev. is 5.5 ± 0.6 $hour^{-1} sterad^{-1}$. By comparing the obtained intensity with the spectrum of the primary radiation and the number of low-energy nuclearactive particles at sea level, one obtains the absorption length for nuclearactive particles. In order to detect the air showers accompanying the nuclearactive particles, 15 cylindrical ionization chambers were used. The obtained integral number-spectrum is shown in a figure. It was found that the percentage of nuclearactive particles, accompanied by air showers, increases monotonically with the energy of the nuclearactive particles, varying between 76 and 88% for energies of $2 \cdot 10^{12}$ to $2.5 \cdot 10^{13}$ ev. The inter- 4

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Energy spectrum of ...

action free-path was calculated by the change in the number of the recorded nuclearactive particles as a function of increasing thickness of the graphite layer above the ionization chamber. It was also found that the integral energy spectrum of nuclearactive particles can be expressed in the form $F(>E) \sim E^{-m}$, where $m = 0.9 \pm 0.2$. This formula apparently characterizes the spectrum of the nuclearactive component as a whole. Further, the energy spectra of nuclearactive components for showers of different total number of particles is determined, as well as for various distances from the shower axis. The procedure used for this purpose is described. The air showers under investigation were divided into 3 groups (according to total number of particles). A peculiar feature of the spectrum at distances of 0 to 1 m was the absence of nuclearactive particles with energies below 10^{11} ev. The integral spectra of nuclearactive particles for the 3 groups of showers are shown in a figure. The spectra are characterized by smooth shape even in the region where a shower contains 1 to 2 particles. By averaging, one obtains the

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Energy spectrum of ...

energy spectrum $F(>E) \sim E^{-0.9 \pm 0.1}$ for $2.5 \cdot 10^{10} < E < 10^{12}$ ev. The dependence of the number of nuclearactive particles on the total number of particles can be expressed as $N^{1.5}$ for the range $N < 10^5$. With $N < 10^5$, the dependence of the number of nuclearactive particles on N changes its character. The comparatively softer character of the energy spectrum of nuclearactive particles with $N > 10^5$ is in qualitative agreement with the results obtained from another series of experiments; it is also one more proof of the possible change in the character of elementary nuclear interaction with primary-particle energies $\geqslant 3 \cdot 10^{14}$ ev. There are 6 figures, 2 tables and 14 references: 12 Soviet-bloc and 2 non-Soviet-bloc. The reference to the English-language publication reads as follows: M Kaplon, J. Klose, D. Ritson, W. Walker. Phys. Rev., 91, 1573, 1953.

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3-2410 (2705, 2805, 1559)

AUTHOR: Zatsepin, G. T.

TITLE: Role of fluctuations in the development of air showers

SOURCE: International Conference on Cosmic Radiation, Moscow, 1959. Trudy. v. 2. Shirokiye atmosfernyye livni i kaskadnyye protsessy, 212-221

TEXT: It is initially assumed that the number of particles in a shower at a given depth is practically independent of the number of particles possessed by the shower at high altitudes. Hence follows that secondary-particle cascades should develop fast and be absorbed (after reaching the maximum) with an absorption length λ considerably lower than 200 gm/cm^2. The altitude variation of showers coincides (to within a factor) with the altitude variation of the nucleonic component of corresponding energy. Further, the energy losses of nucleons are analyzed. It was found that if fluctuations in the development of showers are taken into account, then the altitude variation of showers yields a lower value of the energy

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Role of fluctuations ...

fraction preserved in collisions of high-energy nucleons than would follow from the consideration of average quantities. Let the function $G(y,z,x)dz$ denote the probability distribution that, at primary-particle energies $y = \ln E_0$, the number of particles at depth x corresponds to the interval $(z, z+dz)$, where $z = \ln N$. Comparing the number of showers C_m, computed from average values, with the number of showers C when fluctuations are taken into account, it may be concluded that C_m is smaller than C, viz. 4

$$M = \frac{C_m(z)}{C(z)} = \frac{\left[\int e^{-v} G_1(v,x)dv\right]^{\frac{\gamma}{s}}}{\int e^{-\frac{\gamma}{s}v} G_1(v,x)dv} \qquad (37)$$

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A fast change in the spectrum exponent for showers with N = 10^5 to 10^6 is noted. Hence, it is assumed that in the corresponding energy range (10^{15} to 10^{16} ev.), a very sharp change takes place in either the primary radiation or the characteristics of nuclear interactions. Three alternative models of shower development are proposed. More conclusions are: 1) The development of showers, from protons of moderate energies ($E < 10^{15}$ ev.) at least, exhibits great fluctuations, due to the fact that the secondary cascades (formed by nucleon collisions) are short, and that the nucleons preserve an appreciable energy-fraction in the majority of nuclear collisions. A shower can be schematized in the form of a fir-tree with fluctuating number and size of twigs. 2) The graph representing shower development is no longer a smooth curve with a maximum uniquely determined by the energy of primary particles. Even the "averaged" curve is substantially affected by the level of observation. 3) The energy of primary particles E_0, which generate the shower with given number of particles N at the level of observation, has no

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Role of fluctuations ...

unique relationship with the shower. Theory should only yield the probability $G(E_0,N,x)$ of the shower with given N, being generated by a proton of given energy. 4) Owing to the fast decreasing spectrum of primary protons, the mean energy of primary particles, responsible for the formation of cascades with given N at the level of observation, is lower than the energy of primary particles which generate (on the average) the same number of particles. 5) The mean energy of individual showers with given N is smaller (at the level of observation) than would follow from altitude variations of the shower considered without taking into account fluctuations. 6) The passage from the number of showers to that of primary particles is little affected by fluctuations. 7) Nucleons preserve (in the majority of collisions) a considerable fraction of their energy ($\kappa \simeq 1/2$), for energies E_0 of up to 10^{15} ev. at least. 8) The π- and K mesons which are generated in nuclear collisions, acquire a much smaller energy than the nucleon energy. 9) The experimental results are in agreement with the assumption that the π-mesons undergo a catastrophic energy loss in nuclear collisions. There are

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Role of fluctuations ...

2 figures and 9 references: 8 Soviet-bloc and 1 non-Soviet-bloc. The reference to the English-language publication reads as follows: G. T. Zatsepin. The Oxford Conference on Extensive air showers, Harwell, 1956, p. 8.

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D299/D305

3.2410 (2205, 2805, 1559)

AUTHORS: Dedenko, L. G., and Zatsepin, G. T.

TITLE: Computing some air-shower characteristics with allowance for fluctuations

SOURCE: International Conference on Cosmic Radiation. Moscow, 1959. Trudy. v. 2. Shirokiye atmosfernyy livni i kaskadnyye protsessy, 222-229

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TEXT: The probabilities of the generation of showers of a given number of particles by primary protons, at sea level, are calculated by the Monte Carlo method. The assumptions are stated under which the calculations were carried out. The fixed number of collisions m between nucleons and atoms of air was considered, having a Poisson distribution with mean $\bar{m} = 12.5$. The integral distribution function of the logarithm of number of particles $z = \lg_{10}N$ at the level of observation, was determined by the formula

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Computing some air-shower...

$$\Psi(> z/y) = \sum_{m=1}^{\infty} P_m \Psi^{(m)} \left(> \frac{z}{y}\right) \qquad (5)$$

where P_m is the Poisson weight for the case of m collisions, Ψ is the distribution function of z for m collisions, $y = \lg_{10}(E_0/10^{10}\text{ev.})$, E_o being the energy of the primary proton. The number of showers sampled in 3 cases for proton energies of 10^{13}, 10^{14} and 10^{15} ev. equals 763, 685 and 719 showers respectively. The results of the computations are shown in a figure. As an approximating function, the polynomial of fourth degree

$$\Psi\left(> \frac{z}{y}\right) = a + b(z - y) + c(z - y)^2 + d(z - y)^3 + e(z - y)^4 \qquad (6)$$

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is taken. The differential distribution functions are shown in another figure. It was found that the effect of fluctuations decreases with increasing energy of primary protons. It was also noted that the most probable value of z increases faster than y. Further, the distribution function $\varphi(y/z)dy$ was constructed of energies of protons which generate (at the level of observation) showers with given z for z = 3.8; 4.4 and 4.8. The most probable values of y are 3.52; 4.04 and 4.41 respectively. The effect of fluctuations proved considerable, owing to the fact that, out of all the distributions of proton collisions, those are most effective which generate the comparatively largest number of particles at the level of observation. With regard to the number spectrum and primary-proton spectrum, Fig. 4 shows the number spectrum, line 1 representing the spectrum with allowance for fluctuations, and line 2 - without fluctuations. With fluctuations taken into account, the number of showers increases by a factor of 1.5 approximately, for same intensity of proton flow. Another figure shows the primary proton spectrum. A comparison of the calculated intensity of protons with experimental values (of G. Cocconi) showed that the

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Computing some air-shower ...

calculated value was 4 times smaller than the experimental value. Further, the density distribution function for proton collisions was constructed. The results of the calculations can be extended to the case when the primary particle is a nucleus with atomic weight.A. Further, it is shown how certain shower characteristics can be derived from others. In an appendix, $\pi^{\pm,0}$-mesons, generated as a result of the interaction between a proton and an air atom, are discussed, as well as their decay into photons and successive generations of mesons. There are 7 figures and 5 references: 3 Soviet-bloc and 2 non-Soviet-bloc. The reference to the English-language publication reads as follows: K. Greisen. Prog. Cosmic Ray Physics, v. 3, 1956.

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

ZATSEPIN, G. T.

21(7)

SOV/56-36-3-4/71

AUTHORS: Vernov, S. N., Goryunov, N. N., Zatsepin, G. T., Kulikov, G.V., Nechin, Yu. A., Strugal'skiy, Z. S., Khristiansen, G. B.

TITLE: Investigation of the Core of Extensive Atmospheric Showers (Issledovaniye stvola shirokogo atmosfernogo livnya)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 669-681 (USSR)

ABSTRACT: The group of research scientists followed a suggestion made by D. V. Skobel'tsyn to investigate the passage of extensive atmospheric showers through matter simultaneously in different depths; in this connection an investigation of the shower core was carried out. Figure 1 shows a block scheme of the experimental arrangement used, which furnished data concerning the electron-photon and the nuclear-active components of the shower core. The experimental system consisted essentially of a diffusion chamber ($0.64\ m^2$), 124 ionization chambers in hodoscope-connection, special filters and 672 Geiger-Mueller (Geyger, Myuller) hodoscope counters of different sizes. The method, which is described as new, is described in detail,

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and the possibilities it offers are discussed. The entire device remained in operation for 1300 hours and recorded more than 10,000 passages of extensive air showers. Within 1,000 hours 28 passages of shower cores with a shower particle number of $N > 10^5$ through the first row of ionization chambers were recorded. Figure 4 shows a photograph of the diffusion chamber for such a passage and the corresponding pulse oscillogram of 64 ionization chambers. The article gives numerous individual data concerning different showers as e.g. the ionization distribution in the 64 ionization chambers of the first and second row respectively for $N = 5.10^5$, $1.3.10^5$ and $N \approx 10^5$ with a spatial distribution of energy flux $\sim 1/r^3$ (Fig 6). Figure 8 shows the same, expressed by the number of relativistic particles passing through the ionization chambers of the first and second row for $N = 10^6$ and 2.10^4 and an energy flux $\sim 1/r^2$ and $\sim 1/r$. Figures 6 and 8 show the particle flux distribution in the diffusion chamber for $N = 2.10^6$ and $3.5.10^4$ respectively. In extensive air

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showers with $N > 10^5$ it was observed in the shower core ($r < 1m$) that the total energy of nuclear-active particles is of the order of the energy of the electron-photon component at the same distance from the axis; for individual showers, however, the ratio of these energies showed different values. The energy current density of the electron-photon component shows an increase of up to $r = 20 \div 30$ cm from the shower axis; the course of energy flux density in dependence on r cannot be represented by a general formula. It fluctuates between $\sim 1/r$ and $\sim 1/r^3$. The energy fluxes of electron-photon and nuclear-active components of the shower core show considerable fluctuations (up to 10 times). The authors finally thank Academician D. V. Skobel'tsyn for his help and interest, N. V. Borisoglebskiy for his collaboration, Professor N. A. Dobrotin for his help and discussions, and further also a group of collaborators of the MGU: A. T. Abrosimov, [illegible] Clagolevskiy, B. V. Subbotin, A. D. Yerlykin, A. B. Kamnev, E. N. Sosnov for their help in carrying out experiments. There are 8 figures, 2 tables, and 12 references, 11 of which are Soviet.

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ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)
Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute imeni P. N. Lebedev of the Academy of Sciences, USSR)

SUBMITTED: July 21, 1958

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S/058/61/000/010/025/100
A001/A101

AUTHORS: Alekseyev, I.S., Zatsepin, G.T.

TITLE: High-energy μ-mesons

PERIODICAL: Referativnyy zhurnal. Fizika, no. 10, 1961, 98, abstract 10B517 ("Tr. Mezhdunar. konferentsii po kosmich. lucham, 1959, v. 1", Moscow, AN SSSR, 1960, 326 - 329)

TEXT: The energy spectrum of μ-mesons is determined by solving the equation of meson diffusion in ground. The problem is investigated on the mechanism of production of high-energy ($\sim 10^{12}$ ev) μ-mesons. To determine the energy losses of μ-mesons, the following processes are considered: ionization, bremsstrahlung, generation of electron pairs, production of penetrating showers as a result of interaction of the meson electro-magnetic field with nucleons. Integrated spectrum of μ-mesons is calculated at various assumptions as to the effective cross section of photoproduction of penetrating showers. Possibilities of studying production processes of high-energy μ-mesons are briefly discussed.

L. Dorman

[Abstracter's note: Complete translation]

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"APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001963920007-4

21 (8)

AUTHORS: Zatsepin, G. T., Nikol'skiy, S. I., Pomanskiy, A. A.

SOV/56-37-1-31/64

TITLE: Decay Processes in the Development of Nuclear Cascades in the Atmosphere (Raspadnyye protsessy pri razvitii yadernykh kaskadov v atmosfere)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 1(7), pp 197 - 201 (USSR)

ABSTRACT: As the energy of the primary particle is not directly measured in experiments on atmospheric showers, the development of avalanches must also be considered by giving the initial conditions in the depth of the atmosphere. The usual method of successive generations is not suitable for the solution of such problems. Nucleons and pions are assumed to participate in the nuclear cascade process. The effective cross section of nuclear collisions is assumed to be equally large for nucleons and pions. The initial conditions are assumed to be given in the depth x_0: $N(E,x_0)dE$ and $\Pi(E,x_0)dE$, respectively, are assumed to denote the number of nucleons and $\pi^{\pm}$-mesons, respectively, with an energy

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of E, E + dE in the depth x_0. The kinetic equations are written down in the form $\frac{\partial N(E,x)}{\partial x} = -N(E,x) + \int_0^\infty [N(E',x)W_{NN}(E',E) + \Pi(E',x)W_{\pi N}(E',E)]dE'$, $\frac{\partial \Pi(E,x)}{\partial x} = -\Pi(E,x)(1+\frac{E_\pi}{Ex}) + \int_0^\infty [N(E',x)W_{N\pi}(E',E) + \Pi(E',x)W_{\pi\pi}(E',E)]dE'$. W_{NN}, $W_{N\pi}$, $W_{\pi N}$, $W_{\pi\pi}$ denote the energy spectra of the particles corresponding to the second index which originate in the nuclear collision of a particle with the energy E' (which is designated by the first index). $E_\pi = Mcz_0/\tau_0\rho(z_0) = 1.4 \cdot 10^{11}$ eV denotes the critical energy of the $\pi^\pm$-mesons, at which the probabilities of nuclear collision and of decay in the depth x=1 are equal to each other; $\rho(z_0)$ denotes the density of air in g/cm^3 in the depth z_0. The solution is written in the form of series $N(E,x) = e^{-(x-x_0)}\sum_{i=0}^{\infty} N_i(E,x)$, $\Pi(E,x) = e^{-(x-x_0)}\sum_{i=0}^{\infty} \Pi_i(E,x)$. The series resulting by substi-

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Decay Processes in the Development of Nuclear Cascades in the Atmosphere

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tuting these series into the above-mentioned kinetic equations are represented step by step. In the special case $x_0 = 0$, the solutions pass over into the known solution of the method of successive approximations. In the present solution, all terms of the series are positive, and the series is always convergent if the total energy of particles at x_0 is finite. The solution is, however, more extensive than in the case $x_0 = 0$. In some cases important for the interpretation of the experimental data, the role of the decay process can be considered in a much simpler way. The authors estimate which portion of the energy of the nuclear-active component (which is present in the showers at the altitude of the Pamir station) is consumed for the formation of muons and neutrinos in the further passage through the atmosphere. According to these calculations, at an energy spectrum of the type $E^{-2}dE$ of the nuclear-active component of showers at the altitude of the Pamir, about 50% of its energy must be used up for the generation of muons and neutrinos, thus,

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Decay Processes in the Development of Nuclear Cascades in the Atmosphere SOV/56-37-1-31/64

being missing for the development of cascades. This conclusion is almost independent of the mechanism of the elementary process of nuclear collisions. There are 1 table and 6 references, 5 of which are Soviet.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Institute of Physics imeni P. N. Lebedev of the Academy of Sciences, USSR)

SUBMITTED: February 7, 1959

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AUTHORS: Gerasimova, N. M., Zatsepin, G. T.

TITLE: Disintegration of Cosmic Ray Nuclei by Solar Photons

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 38, No. 4, pp. 1245 - 1252

TEXT: The solar photons are able, thanks to the Doppler effect, to attain an energy which is sufficient for the spallation of cosmic ray nuclei, provided the latters' energy is high enough. If such a nucleus has the mass M, its energy is $E = \gamma Mc^2$, and the energy of the photon, which equals ε_0 in the solar system, in the rest system of this nucleus is $\varepsilon = \varepsilon_0(\gamma + \sqrt{\gamma^2 - 1}\cos\alpha) \approx 2\gamma\varepsilon_0\cos^2(\alpha/2)$, where α is the angle between the trajectories of nucleus and photon in the solar system (cf. Fig. 1). The energy of a solar photon is about 1 ev, and the energy necessary for photo disintegration of a nucleus is of the order of 10^7 ev, so that the nucleus is bound to have an energy of $E \gtrsim 10^{16}$ ev per nucleon (which

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corresponds to 10^7). The fragments formed in such a disintegration depend upon the nature of the reaction, but they incide practically simultaneously into the terrestrial atmosphere and cause correlated extensive air showers; the distance between the shower cores may approximately attain the order of magnitude of 1 km. The authors at first consider the number of photo disintegrations, and assume the solar energy spectrum to be a blackbody spectrum, and the energy spectrum of the various nuclei to be equal. These considerations lead to the result that the number of photo-disintegrations to be expected is of the order of 10^{-4} hour^{-1} km^{-2} steradian^{-1} and is only slightly dependent on the atomic weight of the nucleus. In the following, the energy distribution of the spallated nuclei is briefly discussed. The respective numerical data are given in Table 2. In the last part of the paper the observation probability of such correlated showers is estimated as a function of the distance between the shower cores. The probability distribution is shown in Fig. 3. L. Kh. Eydus et al. (Ref. 14) are mentioned. There are 3 figures, 2 tables, and 14 references: 6 Soviet, 7 US, and 1 British.

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Disintegration of Cosmic Ray Nuclei by Solar Photons

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ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Institute of Physics imeni P. N. Lebedev of the Academy of Sciences, USSR)

SUBMITTED: August 16, 1959 (initially) and October 30, 1959 (after revision)

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B006/B056

24.6900

AUTHORS: Goryunov, N. N., Zatsepin, G. T.

TITLE: Observation of μ-Meson Bursts in a System of Ionization Chambers 19

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 39, No. 2(8), pp. 271 - 275

TEXT: The device by means of which the investigations described here were carried out, consisted of two layers of cubic ionization chambers (cf. Fig. 1). The chambers were close together and covered a square area of 4 m^2. Each layer consisted of 64 chambers. Besides this device, a large number of Geiger-Müller counters, arranged in groups at different distances from the chamber system, were used for recording muon bursts. Fig. 2 shows examples of ionization distributions in the layer of ionization chambers during the recording of inclined muon showers. The results obtained were evaluated from the following viewpoints: 1) Ionization is concentrated only in one of the rows of chambers, and its total

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Observation of μ-Meson Bursts in a System of Ionization Chambers

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amount corresponds to the passage of more than 1,000 relativistic particles. 2) There must be at least four chambers in a straight line, in which ionizations should not differ by more than one and a half times their amount. The number of events selected in this manner amounted to 0.25 ± 0.03 per hour in each row of chambers. A total of 190 events were recorded in both rows. Fig. 3 shows the integral shower spectra (1 - according to the number of relativistic particles in the shower, 2 - according to the total ionization). For constructing the curves, the data obtained in 370 hours of operation of the device were used, assuming that the total number of muon showers of a given number of particles passing through the device exceeded the number measured in the selected angular interval by more than twenty times its amount. For the bursts due to high-energy muons ($E \geq 10^{11}$ ev) inciding upon the horizontal line at equal angles ($\leq 15^{0}$) it holds that the number of showers decreases with the number of particles n as $1/n^2$ or even more steeply. The experiments showed that by means of the system of ionization chambers used by the authors, it is possible to measure not only the number of particles of showers produced by muons, but also to investigate the

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Observation of μ-Meson Bursts in a System of Ionization Chambers

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angular distributions of high-energy muons. There are 3 figures and 5 references: 4 Soviet and 1 US.

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B006/B063

24.6900

AUTHORS: Zatsepin, G. T., Kuz'min, V. A.

TITLE: Angular Distributions of High-energy Muons in the Atmosphere and Their Production Mechanism

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 39, No.6(12), pp. 1677 - 1685

TEXT: In connection with recent discussions (Refs.1-4) on the contribution of K-mesons to pion production in the atmosphere, a theoretical study has been made of high-energy muon distribution with respect to the two production modes $\pi\to\mu+\nu$ and $K\to\mu+\nu$. Theoretical studies on pion decay have been published already earlier; the authors, however, set themselves the task of making a more exact investigation with special regard to decay processes and energy losses. The problem consisted in solving the kinetic equations for: 1) the parent particles π or K, the decay of which is accompanied by muon production, and 2) the muons. The first part is devoted to the first problem. This problem is considered to be three-dimensional, i.e., the initial nucleon, the pion or K-meson produced by it, and the

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Angular Distributions of High-energy Muons in the Atmosphere and Their Production Mechanism S/056/60/039/006/034/063 B006/B063

muon produced by the latter travel along a common straight line. The path length x is measured in nucleon mean free paths λ_0 ($\lambda_0 = 75\ g/cm^2$), and its origin is at the point where the initial nucleon enters the atmosphere. The production spectrum is assumed to be exponential, i.e., the production intensity for an η-meson (π or K) is assumed to be given by $I_0^{(\eta)}E^{-(\gamma+1)}e^{-\mu x}$, and the depth dependence is an exponential function of the absorption coefficient μ which is independent of energy, depth, and angle of inclination of the trajectory. In addition, the mean free path of the η-particles is supposed to be equal to the nucleon mean free path, and that regeneration of the η-particles may be neglected. One obtains the kinetic equation $\partial P^{(\eta)}(x,E)/\partial x = -\left[1+E_\eta(\theta)/xE\right]P^{(\eta)}(x,E)+I_0^{(\eta)}E^{-(\gamma+1)}e^{-\mu x}$, and its solution, i.e., the expression for the flux of η-mesons of energy E at a depth x reads

$$P^{(\eta)}(x,E) = e^{-x}\sum_{i=1}^{\infty}\frac{x^i}{i!}F_i^{(\eta)}(E);\quad F_i^{(\eta)}(E) = I_0^{(\eta)}a^{i-1}E^{-(\gamma+1)}\left[1+E_\eta(\theta)/iE\right]^{-1},$$

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Angular Distributions of High-energy Muons in S/056/60/039/C06/034/063
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where $a = 1-\mu \cdot E_\eta(\theta)$ is the critical energy at which the probability of η-meson decay on the path x=1 is equal to the nuclear collision probability. The kinetic equation for the muons in the atmosphere reads

$$\frac{\partial P^{(\mu)}(x,E,\theta)}{\partial x} = -\frac{mc\lambda_o}{\tau_{o\mu}\varrho(x,\theta)E}P^{(\mu)}(x,E,\theta)+\frac{\partial}{\partial E}\left[\beta(E)P^{(\mu)}(x,E,\theta)\right] + G(x,E,\theta),$$

where m, $\tau_{o\mu}$ are the muon mass and lifetime, respectively; $\beta(E)$ are the muon energy losses per unit path. Muon decay, energy losses, and generation are taken into account by the first, second, and third term, respectively. Considering that $P^{(\mu)}(0,E,\theta)=0$, its solution reads

$P^{(\mu)}(x,E,\theta)=\exp\left\{-v(x,E,\theta)+c\lambda_o x\right\}\int_0^x G(t,\varepsilon(E,x-t))\exp\left\{v(t,E,\theta)-c\lambda_o t\right\}dt$, where

$v(x,E,\theta) = (mc\lambda_o/\tau_{o\mu})\int_{x_o}^{x} dt/\varrho(t,\theta)\varepsilon(E,x-t)$ and $\varepsilon(E,x-t) = E\exp(c\lambda_o(x-t))$

$+ (\beta_o/c)\left\{\exp(c\lambda_o(x-t))-1\right\}$. The energy of the muon x_o is a constant which

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may be set equal to 1. Finally, the muon source function $G(x, \varepsilon)$ is studied, and the angular distributions for muons with an energy of $10^{11} - 10^{14}$ ev are numerically calculated and graphically represented in Fig.1. It has been shown that in the energy range of $10^{11} - 5 \cdot 10^{12}$ ev, the muon angular distribution is essentially dependent on the production mechanism. P. P. Alekseyev and I. S. Alekseyev are mentioned. There are 2 figures, 3 tables, and 11 references: 8 Soviet, 1 US, and 1 Italian.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Institute of Physics imeni P. N. Lebedev, Academy of Sciences USSR)

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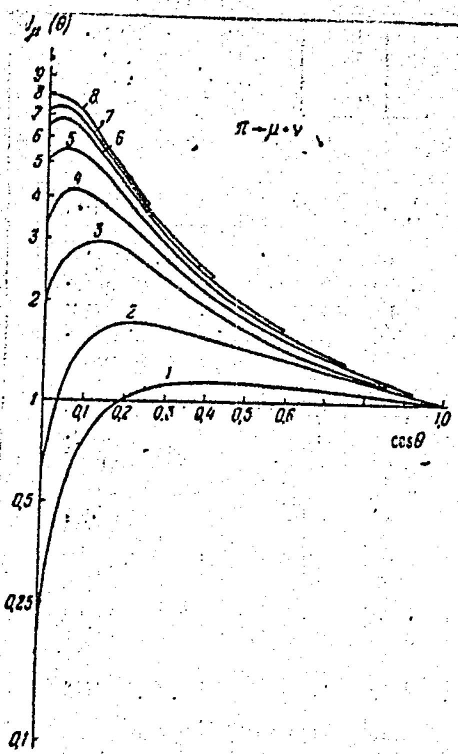

Fig. 1
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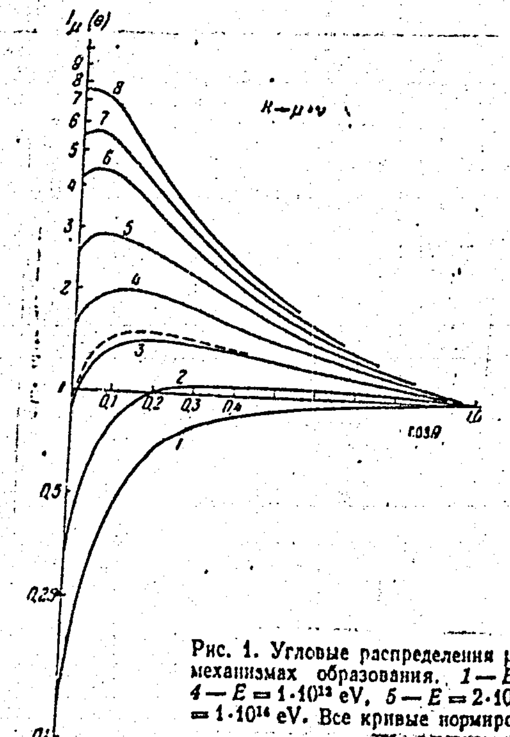

Рис. 1. Угловые распределения μ-мезонов различной энергии E в атмосфере при двух механизмах образования. $1 - E = 1\cdot10^{11}$ eV, $2 - E = 2\cdot10^{11}$ eV, $3 - E = 5\cdot10^{11}$ eV, $4 - E = 1\cdot10^{12}$ eV, $5 - E = 2\cdot10^{12}$ eV, $6 - E = 5\cdot10^{12}$ eV, $7 - E = 1\cdot10^{13}$ eV, $8 - E = 1\cdot10^{14}$ eV. Все кривые нормированы к соответствующей интенсивности в вертикальном направлении.

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B006/B063

24.6900

AUTHORS: Berezinskiy, V. S., Zatsepin, G. T.

TITLE: Some Energy Relations Deduced by Taking Into Account Non-conservation of Parity in the μ-e Decay

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 39, No. 6(12), pp. 1847-1849

TEXT: The energy transferred to the electron component in the decay of partly or completely polarized muons has been calculated. The energy of a decay electron in the laboratory system is given by $E_e = \gamma(E_{ec} + \beta p_{ec} \cos \Theta_{\mu e})$, where γ is the Lorentz factor of the muon; β is its velocity; E_{ec} and p_{ec} are the energy and momentum of the electron in the rest system of the muon; $\Theta_{\mu e}$ is the angle between the momentum of the electron in the muon rest system and the direction of motion of the muon in the laboratory system; c is set equal to 1. With $\bar{p}_{ec} = 0.05\ m_{\mu}$ one

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obtains $\overline{E}_{eo} = (7/20)m_\mu$ for the mean electron energy in the muon rest system, and $K_{e\mu c} = \overline{E}_{eo}/m_\mu = 7/20$ for the mean muon energy, $K_{e\mu c}$, carried away by the electron. For completely polarized muons, $K_{\mu e} = \overline{E}_e/\gamma m_\mu = (\overline{E}_{eo} + \beta \overline{p_{eo}\cos\theta_{\mu e}})/m_\mu = 0.35(1 \pm \frac{1}{7}\beta)$. The plus sign holds for a μ^+ meson polarized in the direction of motion. The sign changes on transition to a μ^- meson or in the case of opposite polarization. If the pion-decay neutrino (antineutrino) travels in opposite direction to the muon, the relation $K_{e\mu} = 0.35(1 - \frac{1}{7}\beta)$ holds for the $\pi - \mu - e$ decay, irrespective of the pion charge; if it travels in the same direction, then $K_{e\mu} = 0.35(1 + \frac{1}{7}\beta)$, and if $\beta = 1$, then $K_{e\mu} = 0.40$. For unpolarized mesons one obtains $K_{e\mu} = 0.35$, and for partly polarized mesons, a value between 0.3 and 0.4. In addition, the energy fraction imparted to the electron component during the decay of $\pi^\pm$ mesons in a vacuum has been calculated.

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$E_{e\pi} = \gamma(\overline{E}_{ec} - \beta\overline{p}_{ec})$, and with $\overline{E}_{ec} = 0.35m_{\mu}$ and $\overline{p}_{ec} = 0.05\ m_{\mu}$ one obtains $K_{e\pi} = E_{e\pi}/m_{\pi} = 0.15 + 0.2\ m_{\mu}^2/m_{\pi}^2 = 0.2646$. The result is not affected by a transition from the pion rest system to the laboratory system. For the $K_{\mu 2}$ decay one obtains $K_{eK} = 0.159$.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Institute of Physics imeni P. N. Lebedev, Academy of Sciences USSR)

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B013/B060

AUTHORS: Dobrotin, N. A., Grigorov, N. L., Zatsepin, G. T., Ivanenko, I. P., Charakhch'yan, A. N., Chudakov, A. Ye.

TITLE: Sergey Nikolayevich Vernov (On His 50th Birthday)

PERIODICAL: Uspekhi fizicheskikh nauk, 1960, Vol. 72, No. 1, pp. 153 - 155

TEXT: Sergey Nikolayevich Vernov celebrated his 50th birthday on July 10, 1960. The beginning of his scientific activity coincided with the beginning of an intensive research on cosmic rays (1931-1932). By his first studies he built the foundation for the present-day methods of investigating cosmic rays inside and outside of the stratosphere by means of radio signals emitted by automatic devices. From the start, Vernov worked in close contact with Academician D. V. Skobel'tsyn. In 1939, he completed a series of studies on cosmic rays in the stratosphere, measured at various latitudes. Stratospheric measurements made by Vernov from 1946 to 1949 yielded particularly detailed information on the nature of primary radiation. Basing on rules found by experiments

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Sergey Nikolayevich Vernov (On His 50th Birthday) S/053/60/072/001/005/005 B013/B060

to govern the absorption of the primary components in the atmosphere, Vernov reached an important conclusion concerning a strong interaction of the primary particles of cosmic radiation with matter. In 1949, S. N. Vernov headed an expedition of Soviet physicists to the equatorial latitudes in the Indian Ocean. Stratospheric investigations made in the course of that expedition yielded convincing evidence of the existence of the disputed, so-called east-west asymmetry and of the positive charge of particles of cosmic radiation. For his research of cosmic radiation in the stratosphere, Vernov was distinguished with the Stalin Prize of 1st Class in 1949. From 1947 to 1949, Vernov organized comprehensive studies of the interaction of high-energy protons with matter in the stratosphere. Collisions of protons with atomic nuclei were found to give rise to an electron-photon component of cosmic radiation. This allowed the assumption that rapidly decaying mesons giving rise to the formation of photons and electrons are produced in the course of such processes. This hypothesis was confirmed by the discovery of π^0-mesons. In 1949 and 1951, Vernov and collaborators obtained experimental data confirming the presence of nuclear cascade processes in 10^{10}-ev primary cosmic particles. Vernov supervised comprehensive research work on the

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